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hydrogen as would unite with oxygen in the formation of water; and this is the theory contained in most modern text-books on combustion prepared for the use of English-speaking students, and generally employed in calculations by the scientific men of England and the United States.

About the year 1860, Messrs. Scheurer-Kestner and Meunier-Dollfus made experiments on the heat evolved by the combustion of various coals; using the same method as that employed by Messrs. Favre and Silbermann, and checking the latter's experiments on wood charcoal and hydrogen gas, before testing the coals. The experiments on coals showed that it was incorrect to calculate the heat of combustion of coal from the heat of its combustible constituents as determined by Favre and Silbermann; or, in other words, that it was not correct to assume that the carbon in coal was of the same density as wood charcoal, and that the hydrogen of the coal was in a gaseous state: these being the necessary assumptions, when Messrs. Favre and Silbermann's constants are used in the formula to which reference has been made above. The report of Messrs. Scheurer-Kestner and Meunier-Dollfus has been well named 'classical,'—all operations and calculations being fully detailed,—so that, speaking rationally or scientifically, the conclusion seems inevitable that a scientific investigator must either find some error or accept the results. Well, how has the scientific world, that is to say, the English-speaking scientific world, received these results? Generally by ignoring them, and going on in the good old way, according to the creed formulated by Messrs. Favre and Silbermann. Here is a scientific (?) statement made by one investigator who has carefully studied the report (Mr. B. F. Isherwood, in *Journal of the Franklin Institute*, July, 1884):—

"The results of the calorimetric experiments made by Scheurer-Kestner and Meunier-Dollfus on the heat of combustion of the Alsatian coals, were never accepted by the British scientists, notwithstanding that no error was ever pointed out in either the apparatus or the method employed. Nor could the writer ever accept them, although he bestowed the closest scrutiny and study upon them."

This is science, with a vengeance! "I can't find any mistakes in the methods or calculations," says the scientist, "but the results are opposed to my present belief, and I can't accept them. I have published numerous treatises containing calculations founded on the methods and data of Favre and Silbermann, and these new results, which would condemn my work, must be ignored or denied."<sup>1</sup>

The statement contained in the above quotation, that the results of the experiments made by Messrs. Scheurer-Kestner and Meunier-Dollfus were never accepted by the British scientists, is not absolutely correct. Mr. John Percy, in the last edition of his treatise on fuel, gives the results, and calls attention to the inaccuracy of the ordinary method of calculation. Similar corrections are made in the last supplement of Watt's 'Dictionary of Chemistry.'

Quite recently, Messrs. Scheurer-Kestner and Meunier-Dollfus have repeated their former experiments, obtaining substantially the same results as before; and it seems probable that right methods of calculating the heat of combustion of coal will be generally adopted before long. If the results are true, they will certainly be accepted, some day; but the length of time during which they have patiently awaited admission to the temple inhabited by English-speaking scientists is a sufficient answer to the question, 'If a new fact, overturning some established theory, is presented, do the scientists examine it critically, and either disprove or accept it, or do they ignore it as long as they can, and only take it into their hearts when worn out by its persistent demands?' If a *truth* is announced, there need be no fear that it will not prevail in the end; but numerous facts, similar to that just cited, sufficiently disprove

<sup>1</sup> Scientific men seem to hunt in couples, so to speak; and Mr. Bonney, in answering the Duke of Argyll (*Nature*, Nov. 24), argues in the same manner as his American brother in the above quotation. He does not accept the new theory, and thinks that no reasons are required for his disbelief. Here are his words:—

"To conclude, the Duke still—and this is our special complaint—treats the matter rather according to ecclesiastical than to scientific method. He is fully persuaded of the excellence of Mr. Murray's hypothesis, and considers it to be 'one of those discoveries in science which are self-luminous,' and 'must carry conviction to all.' Very well, but there are some people, not very few in number, who do not share this opinion."

Hail to the new science, announced by Mr. Bonney! The voice of many people is the voice of God.

the theory fondly entertained by many scientists, that they have reached the ideal state where they desire only to know the truth, regardless of consequences.

Another brilliant French writer, Mr. Alexander Dumas, well sums up the matter, as follows:—

"Il est vrai que peut-être les contemporains ne me croiront pas. . . . Qu'importe! je l'aurais dit; d'autres me croiront: la vérité est une de ces, étoiles qui peuvent rester des mois, des années, des siècles, dans les profondeurs du ciel, mais qui finissent toujours par être découvertes un jour ou l'autre. J'aime mieux être le fou qui se voue à la recherche de ces étoiles-là, que le sage qui salue et qui adore, les uns après les autres, tous ces soleils que nous avons vus se lever, que l'on nous a donnés pour des astres immutables, et qui, à tout prendre, n'ont jamais été que des météores plus ou moins durables, plus ou moins brillants, plus ou moins trompeurs, toujours fatals!"

RICHARD H. BUEL.

New York, Dec. 7.

#### The 'Act of God' and 'Fuerza Mayor.'

MR. APPLETON MORGAN'S 'Act of God' and Mr. Nevin's 'fuerza mayor' appear to me to be pretty much alike, and to threaten a new peril to railway travel,—a peril, according to Mr. Nevin, which in Mexico is already to be encountered. I tremble to think what might happen, for example, if the engineer of the locomotive should happen to sneeze just as he passed a signal that a bridge had been carried away somewhere on the Mexican Central Railroad by "the flooding of a river." Here would be a double 'fuerza mayor'; for an inclination to sneeze is certainly irresistible, and, besides, "the flooding of a river" certainly relieved from the responsibility for the irresistible inclination, even if, according to Mr. Nevin, it did not relieve the watchman from the duty of putting up the danger-signal. But, although we may have to take our lives in our hands when we travel by rail in Mexico (according to Mr. Nevin), I hope that time has not yet come in the United States.

In short, this is the actual practical answer to Mr. Morgan's cleverly reasoned and delightfully *insouciant* paper. It may not be the answer a railway lawyer would write, or would recognize as sufficient, but, from the travelling public's standpoint, it is all there is to be said. It is all very well for the sleek attorneys of great railroad corporations to say that so long as the company provides, as Mr. Morgan says, "the last improvement in safety-insuring devices," its responsibility for the safety of those it transports ceases. "Let us bow to the Divine Will, gentlemen of the jury," says Mr. Morgan. "An overruling Providence has decreed that my client should 'roast thirty-two human beings in slow agony on a floor of ice at White River. But our track was in perfect order, our engine was all right, we were running on time. We are not legally to blame.'" Would Mr. Appleton Morgan have bowed to the Divine Will if he had happened to have been rescued in a half-roasted condition at White River, less an arm, or an eye, or a leg? I venture to say he would have done nothing of the sort. I venture to say he would have commenced proceedings against the company for twenty-five thousand or fifty thousand dollars as soon as he could swear to a complaint. And yet Mr. Morgan will concede that the accident at White River could not have happened in spite of the Divine Will.

The people of this nation do not exist at the will and pleasure of the railway-companies; nor is this nation governed by Mexican laws. Mr. Morgan's familiarity with his subject enables him to write very plausibly concerning the rights and duties of railway-companies; but he cannot convince me, for one, that they are not more sinning than sinned against. If the principle of the 'Act of God' is to be resurrected in the United States, as in Mexico, where is the line to be drawn, and who is to draw it,—the railway-companies, or their ingenious lawyers?

GEORGE BRADWIN.

Jersey City, Dec. 6.

#### The Flight of Birds.

My friend, Prof. Frank H. Storer, has called my attention to an important note on the wings of birds, by that accurate and indefatigable investigator, Prof. Jeffries Wyman. It is to be found on p. 169, vol. v., *Proceedings of the Boston Natural History Society*. This note is all too short, but forms an interesting adjunct to the

paper by Professor Trowbridge, read before the National Academy, and noticed in *Science* of Nov. 18, 1887. Those who heard or have read Professor Trowbridge's paper will remember that it reported the discovery by his son of a peculiar structure in the primary wing-feathers of soaring birds, by which they are locked when expanded, and are thus maintained in position without muscular effort. This structure is shown only in the primary feathers, and is therefore a character belonging to the last division of the arm.

Professor Wyman, in the note referred to, describes "a peculiar arrangement of the bones and ligaments in the wing of the pin-tailed duck, by which, while the wing is fully extended, all the segments of this extremity are fixed and retained in position independently of muscular action." His account of the mechanism of the wing is as follows:—

"The structure of the articulations of the elbow and wrist is such, that during flexion and extension the radius advances and recedes upon the ulna, carrying with it the upper carpal bone, and this last the hand: in this way flexion and extension of the bones are effected. The lower carpal bone is attached to the upper by strong ligaments: consequently, when the upper carpal bone is drawn over the extremity of the ulna as the radius recedes, the lower one is drawn up between the hand and the extremity of the ulna, and, acting as a wedge, maintains the hand extended, until it is displaced by the reversed action of the radius." This structure, according to Professor Wyman, shows how the extension of the bony framework of the wing may be maintained indefinitely without fatigue. The structure of the primary wing-feathers described by Professor Trowbridge indicates that they too may be locked in position, and thus the rigidity of the wing may be maintained automatically to its extremity.

None of the members of the National Academy who took part in the discussion which followed the reading of Professor Trowbridge's paper seemed to have any knowledge of this discovery of Professor Wyman; and it was remarked, that, while the facts cited by Professor Trowbridge seemed to explain the automatic extension of the primaries which are appendages of the *manus*, the rigidity of the arm itself, apparently manifested in the flight of soaring birds, was yet unaccounted for. That missing link was supplied by Professor Wyman, but, from his characteristic modesty, so quietly announced that it has been known to few.

The case cited by me at the meeting of the National Academy was a turkey-buzzard, shot when soaring over the prairies in the Sacramento valley. Its wings remained rigidly extended, and it descended slowly like a parachute and settled in the grass very near me, quite dead; even then the wings remaining expanded.

Professor Storer gives other interesting examples. He says, "Upon the New England seaboard nothing is more familiar to old gunners than the phenomenon that a bird shot in mid-air will often 'set his wings' and scale down toward the horizon, to reach the water dead, often at a great distance from the boat whence the shot was fired. Even in childhood I remembered to have wondered, when 'assisting' at the shooting of duck and coot, as to the meaning of the not infrequent exclamation, 'That fellow has set his wings; watch him!'"

Dr. Storer writes that he was present at the meeting of the Boston Natural History Society, Sept. 1, 1855, when Professor Wyman exhibited his preparation of the duck's wing, and gave an explanation of its structure which seemed a demonstration.

Now, if some good anatomist would review the subject again, combine the results reached by Professor Wyman and Professor Trowbridge, and illustrate his memoir with good figures, he would make an important contribution to biological science.

J. S. NEWBERRY.

New York, Dec. 10.

#### The Origin of the Tritubercular Type of Mammalian Dentition.

PROFESSOR COPE has fully demonstrated that the molar teeth of many divisions of the higher mammalia are derived from the tritubercular type of molar which is so abundant in the mammals of the Puerco, or lowest eocene period. He has further ('Origin of the Fittest,' p. 347) shown that the tritubercular type may be traced back to the single cone of the reptilian crown by the follow-

ing succession: 'first, a simple cone or reptilian crown alternating with that of the other jaw; second, a cone with lateral denticles; third, the denticles to the inner side of the crown forming a three-sided prism, with tritubercular apex, which alternates with that of the opposite jaw,' etc. In the last meeting of the American Association for the Advancement of Science, Professor Cope applied this succession to the origin of what he has called the 'tubercular-sectorial' molar, citing the molars of Owen's genus *Spalacotherium* as an instance of the transformation into the tritubercular crown *in process*. I had independently arrived at the same conclusion, and, moreover, found that the origin of the tritubercular crown in all its various stages could be traced in the mesozoic mammalia. This is traced in a memoir now publishing by the Philadelphia Academy. I am glad to be able to confirm Professor Cope's views in every particular, for his numerous and suggestive papers upon the mechanical genesis of tooth forms have placed comparative anatomists generally in his debt. Among the mesozoic mammalia the simple large cone with small lateral denticles is seen in the American triassic genus *Deomotherium*. From the same beds *Microconodon* furnishes a more advanced stage in the growth of the lateral denticles into cusps. The mandibles of Jurassic genera *Phascolotherium*, *Menacodon*, *Spalacotherium*, furnish three stages of the rotation inwards of the lateral cusps, accompanied probably by the rotation outwards of the lateral cusps in the upper jaw. In *Stylodon* this process is complete, the teeth being distinctly tritubercular, with the addition of a posterior heel, the upper molars reversing the pattern of the lower. In another line of genera the lateral cusps show no tendency to rotate inwards, but continually augment in size, such as *Triconodon* and its successors, leading to the modern *Thylacinus* type of molar. In *Amphitherium* and many other genera it appears as if the posterior lateral cusp had never been acquired, and the crown is re-enforced by the inward extension of the cingulum, as seen in an early stage in *Diplocynodon*. In *Kurtodon*, by the union of the external tubercles in the upper jaw, we observe a columnar molar of the rodent type. It now appears as if we should soon be in possession of sufficient data to trace the entire history of the multi-cuspid and multi-fanged mammalian molar from the single reptilian cone and fang.

HENRY F. OSBORN.

Princeton, N.J., Dec. 12.

#### Iroquois and Eskimos.

IN connection with the discussion which has recently appeared in *Science* on the ancient relations of the Iroquois and Eskimos, a passage which I recently came across in the manuscripts of the Moravian missionary Christopher Pylæus is worthy of note.

The active work of Pylæus was between 1740 and 1750, and he became an accomplished scholar in one or more of the Iroquois dialects. In July, 1749, the Iroquois sent a deputation to a council at Philadelphia, when Pylæus acted as interpreter. In his notes of his conversations with the deputies he has the following:—

"*Tschiechrohne* heissen die Grönländer; . . . *Tschie*, ein Seehund. Die drei obgenannte Seneker wussten nicht nur von den Grönländern, sondern auch ihrer Contry (*sic*), Landsart, Kleidung, Nahrung," etc.

Of course, Pylæus used the term 'Greenlanders' as generic for 'Eskimos.' Evidently the Iroquois, who pushed their war parties to the south as far as the present State of Louisiana, carried their excursions also as far north as the shores of the Frozen Ocean.

D. G. BRINTON.

Media, Penn., Dec. 7.

#### The Sioux.

IN your issue of Nov. 25 (p. 264) your correspondent from Lexington, Mo., says, "The Sioux call themselves *Lah-ko-ta*." In this he is correct; but when he adds, "not Dakota," he is in error. The sounds of *l* and *d* are interchanged among certain Dakota dialects. The Sioux who dwell east of the Missouri say *Dakota*, while most of those on the west side (Tetons) say *Lakota* (*vide* Riggs's *Grammar and Dictionary of the Dakota Language*, p. 133).

In giving the meaning of the name as 'cut-throats,' he is at variance with the best authorities on the Dakota language.

W. MATTHEWS.

Washington, D.C., Nov. 26.